DISSEMINATION BY ANTS OF THE SEEDS OF TRILLIUM GRANDIFLORUM

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The fruit of *Trillium* is three-celled, subglobose, varying around one-half inch in long diameter and contains numerous seeds. When ripe, separating at the calyx, the fruit falls to the ground without opening, but seeds are exposed at the base of the capsule where it is detached. The seeds are relatively large, easily seen, and change in color, on exposure to the air, from a whitish or light brown to a darker, reddish brown. On removal from the fruit, the ovate seeds appear to be coated with a viscous or gelatinous substance, which will dry. Moisture apparently revives this viscosity. (The viscous or gelatinous quality suggests that there may be an adaptation for seed-dispersal by means of adhesion to animals.) At the hilum is a spongy caruncle, roughly one-fourth the bulk of the seed. Similar fleshy material forms the axis of the fruit. The capsule when quite empty is thin and papery. Apparently, the plant has no mechanical means of scattering its seeds.

For experimentation on the germination of seeds of *T. grandiflorum* Salisb. we had received a request for all of the fresh seeds which could be procured from our plants. The first fruits ripened, falling readily into the hand, on July 13, 1939 (Worcester, Mass.), four fruits being collected that evening. The next morning a number of fruits had ripened and had fallen to the ground. Surprisingly, on examination not one of these had a seed remaining in it; after a prolonged search, not a seed could be found on the ground. Examination of empty capsules revealed that they had been thoroughly cleaned out, leaving only the thin, papery shell. It was far from apparent how these viscous seeds could have completely disappeared from the capsules and the ground in such a short time. There had been no rain. The next day more ripened fruits were collected; more emptied capsules were seen beneath the plants, all quite devoid of seeds. It was recalled then, that on the previous day, two empty capsules each contained a black ant. Instantly, a relationship between ants and the disappearance of the seeds was suspected.

A test was made. A freshly harvested fruit was offered to a black ant (species undetermined) crawling on the ground. With apparent familiarity, she at once mounted the fruit, at the freshly-exposed end. Within a few seconds she dug out a seed, adjusted it in her mandibles,

and started off. She was traced. Presently, she disappeared among a heap of small garden-stones (about a half-pailful). Simultaneously, numerous Trillium seeds were observed scattered about the base of the stone pile. A second ant found under the Trillium plants, was offered a freshly picked fruit, but before it could be placed on the ground, she reared, and turned toward the fruit, exhibiting a positive interest in it. She, like the other ant, extracted a seed and carried it off in the direction of the stone heap, about twelve to fifteen feet from the Trillium plants.

Seeds scattered about the base of the stones were gathered with forceps. Then, one-by-one, the stones were carefully removed, thus exposing many more seeds, seemingly dropped between stones and not in the small galleries beneath stones. Quite conclusively, the seeds had been discarded by the ants. No seed was found more than eighteen inches from the stone pile. In all seventy seeds were recovered.[1]

As more stones were removed, the entire colony was found to have concentrated beneath a larger stone, about the size of a hand. In the midst of this confusion, two ants were seen, each carrying a fresh Trillium seed with the caruncle. Doubtless these were the seeds offered but a few minutes before in the tests. The ant colony was estimated at around five hundred individuals. No larvae or pupae were seen. There was no apparent gallery or tunnel below the surface of the ground. All galleries or chambers were found beneath the small stones. At first regarded as a temporary nest, in reality this was probably a permanent one.

There was no indication that the ants used the seeds in any manner comparable to the ways of the harvester-ants; not one seed was found eaten, nor was there the slightest evidence of storing. On the contrary, the seeds were quite definitely scattered and discarded around the nest. The caruncle (and possibly the gelatinous coating) appeared to have been eaten off consistently. Fleshy material, in appearance like the caruncle, occurs in the capsule, which the ants clean out apparently for food. There is evidence that the fruits may be eaten into, before they fall from the plants; a number were observed gnawed at the point of attachment, but whether a seed had been removed, could not be positively determined. Black ants were seen exploring all over the plants, particularly after the last fruit had been harvested.

[1] Sir John Lubbock (1894) is quoted as having seen ants carry seeds to their nests, but it is not clear what seeds or for what purpose.

There is no doubt of the appeal of the caruncle to the ants; it attracts them no less than nectar attracts bees. Quoting William Morton Wheeler (Ants . . . 1910. p. 315), "Surnander (1903) and other botanists believe that ants eat the caruncles." The present study seems to confirm that hypothesis, especially so, since there had been no rain between the first ripening of the capsules and the final observations.

Bloodroot seeds, *Sanguinaria canadensis* L., have caruncles. These observations on Trillium seeds are paralleled by those of Dr. E. B. Southwick as told by Dr. Wheeler (ibid). Dr. Southwick observed ants carrying off bloodroot seeds and feeding on the caruncles. In the writer's garden this may account for the recent appearance of a bloodroot seedling, some twenty feet upgrade from the nearest group of bloodroot plants.

These two New England natives, *Trillium grandiflorum* and *Sanguinaria canadensis*, lack mechanical means of seed-dispersal. Each have ample caruncles, seemingly of food value to ants, which, serving as lures, suggests that seed-dispersal is accomplished through the agency of ants. Seeds discarded in the debris of ant nests should find a favorable medium for germination.

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CYPERUS MICROIRIA ON LONG ISLAND.—A specimen collected at Hempstead, Long Island, by E. P. Bicknell in 1906 and first recorded in the 2nd edition of Britton & Brown's Illustrated Flora I, 301 (1913) as *Cyperus Iria* L., was referred to *C. amuricus* Maxim. by Prof. Fernald and Mr. Griscom in RHODORA XXXVII, 148 (1935). There are, however, two closely allied species in Eastern Asia which are distinguished from *C. Iria* in having distinctly mucronate scales, i. e. *C. amuricus* Maxim. and *C. microiria* Steud. The difference between the two plants was clearly pointed out in Bot. Mag. Tokyo XLVII, 236–239 (1933) by Prof. Nakai who carefully examined authentic specimens of related species during his trip in Europe. A specimen from Long Island well agrees with Japanese specimens of *C. microiria* and is not the true *C. amuricus* of which I have also examined the isotype specimen in the Gray Herbarium. *C. microiria* differs from *C. amuricus* by having shortly mucronate scales which are generally more yellowish and more compound inflorescences, and is an inter-